What is claimed is:

1. A system for extracting information from a complex signal, comprising:

a decomposition module disposed to derive a snapshot of input signal components from said complex signal;

a memory storing reference snapshots of signal components characterizing recognized states of said complex signal; and

an empirical modeling engine applying a similarity operator to said input signal components against said reference snapshots to generate at least one similarity measure, said similarity measure providing information about the state of said complex signal.

2. A system for extracting information as in claim 1, wherein said decomposition module derives each said snapshot from said complex signal using wavelet analysis to decompose said complex signal into a plurality of component coefficients.

3. A system for extracting information as in claim 1, wherein said decomposition module comprises a plurality of frequency filters for filtering said complex signal to derive said snapshot of input signal components.

4. A system for extracting information as in claim 1, wherein said empirical modeling engine generates said similarity measure as a function of elemental similarity values between corresponding components of the input snapshot and a reference snapshot.

5. A system for extracting information as in claim 4, wherein said empirical modeling engine generates an elemental similarity value for a selected component

according to a mapping into a range between a minimum and maximum of that component across the reference snapshots.

6. A system for extracting information as in claim 1, wherein said complex signal is a communication signal, said system further comprising a lookup table, said empirical modeling engine matching said snapshot with a reference snapshot in said memory based on the at least one similarity measure, said matching reference snapshot identifying an entry in said lookup table, said identified lookup table entry being presented as an output of said system.

7. A system for extracting information as in claim 1, wherein said signal is generated from a system being monitored and said empirical modeling engine generates expected values for at least one of the signal components of said complex signal based on the at least one similarity measure, said system further comprising:

an adder for combining an expected value and a corresponding signal component and determining a residual value therefrom; and

a test unit for determining a deviation based on the residual.

8. A system for extracting information as in claim 7, further comprising a diagnostic unit responsive to deviation determinations from said test unit for generating a diagnosis of a condition in the operation of the monitored system.

9. A system for extracting information as in claim 7, wherein said test unit applies a threshold to the residual to determine a deviation.

10. A system for extracting information as in claim 7, wherein said test unit applies a sequential probability ratio test to a sequence of values of the residual to determine a deviation.

11. An apparatus for monitoring the operating condition of a system, comprising:

sensor means for acquiring a time-varying signal characterizing operation of the system;

means for decomposing said time-varying signal into a plurality of components;

a memory for storing a plurality of reference snapshots of component values for known operating conditions; and

processor means responsive to the decomposing means, disposed to generate estimates of the components using a similarity operation on the component values from the decomposing means with reference to the component values in each reference snapshot in the memory, and further disposed to generate residual values by differencing the component values and the estimates thereof, for determination of deviating operating conditions of the system.

12. An apparatus according to claim 11, wherein said processor means is further disposed to perform a sequential probability ratio test on successive residual values for determining deviating operating conditions of the system.

13. An apparatus according to claim 11, wherein said processor means generates said estimates using a similarity operator in which a difference between two values is normalized with an expected range for said values.

14. An apparatus for classifying a state of a system, comprising:

sensor means for acquiring a time-varying signal characterizing the system;

means for decomposing said time-varying signal into a plurality of components;

a memory for storing at least one reference snapshot of component values for at least one known state of the system; and

processor means responsive to the decomposing means, disposed to use a similarity operator to generate a similarity value for a comparison of the components from the decomposing means and the at least one reference snapshot, and determine if the system is in said known state based on the similarity value.

15. An apparatus according to claim 14, wherein the memory contains a plurality of snapshots of component values representing a plurality of known states, and said processor means determines the state of the system to be the known state associated with the reference snapshot having the highest generated similarity value.

16. An apparatus according to claim 15, wherein each known state represented in the memory has just one reference snapshot associated with it.

17. An apparatus according to claim 14, wherein said decomposing means uses wavelet analysis to decompose the time-varying signal into coefficients.

18. An apparatus according to claim 14, wherein said decomposing means uses frequency filters to decompose the time-varying signal into component signals.

19. A method for providing a reference library of representative sets of correlated values for use in monitoring a system using an empirical model, comprising the steps of:

receiving a variable signal measuring a parameter of said system during operation of said system in a known mode;

decomposing said variable signal into component signals;

sampling said component signals periodically to provide successive sets of correlated values; and

selecting some of said sets of correlated values for inclusion in said reference library.

20. A method according to claim 19, wherein said decomposing step comprises transforming said variable signal with a discrete wavelet transformation to produce component signals comprising successive wavelet coefficients.

21. A method according to claim 19, wherein said decomposing step comprises filtering said variable signal with a plurality of frequency bandpass filters to produce component signals for each band of frequencies.

22. A method according to claim 19, further comprising storing in said reference library a classification with a selected set of correlated values, associated with a known state of the variable signal.

23. A method according to claim 19, wherein said selection step comprises including a particular set of correlated values if said particular set includes a minimum or a maximum value of one of the correlated values, as compared to all like values in all the sets of correlated values.

24. A method for classifying a state of a system, comprising:

receiving a time-varying signal characterizing the system;

decomposing said time-varying signal into a plurality of components;

generating a similarity value for a comparison of said plurality of decomposed components and a reference set of component values representing a known state of the system; and

determining if the system is in said known state based on the similarity value.

25. A method according to claim 24, wherein said generating step comprises generating a similarity value for each comparison of the decomposed components to each of a plurality of reference sets of component values representing a plurality of known states of the system, and said determining step comprises selecting the known state associated with the reference set having the highest generated similarity value as the determined state of the system.

26. A method according to claim 25, wherein each known state has just one reference set of component values associated with it.

27. A method according to claim 24, wherein said decomposing step comprises using wavelet analysis to decompose the time-varying signal into coefficients.

28. A method according to claim 24, wherein said decomposing step comprises using frequency filters to decompose the time-varying signal into component signals.

29. A method of extracting information from a complex signal, said method comprising the steps of:

a) receiving a complex signal, said complex signal carrying data therein;

b) periodically decomposing said received complex signal into a plurality of components;

c) comparing said components against a plurality of snapshots in a storage set of historical components;

d) averaging comparison results from comparing said components against said snapshots, said average comparison results providing an indication of information in said complex signal.

30. A method of extracting information as in claim 29, wherein the step (b) of periodically decomposing said received complex signal comprises extracting wavelet detail levels from said complex signal.

31. A method of extracting information as in claim 29, wherein the comparison step (c) comprises applying a bounded area ratio test to each of said plurality of components, each component being compared against a corresponding component in each of the plurality of snapshots.

32. A method of extracting information as in claim 31, said method further comprising the steps of:

e) identifying a matching historical signature vector among said plurality of snapshots responsive to said average comparison results; and

f) outputting a digital result corresponding to said identified matching historical signature vector.

33. A method of extracting information as in claim 31, said complex signal being generated responsive to a system being monitored, said method further comprising the steps of:

e) generating an expected signal result from averaged said comparison results;

f) generating a residual from said expected signal result and said decomposed received complex signal; and

g) testing said residual to determine whether said expected signal result is different from said received complex signal.

34. A method of extracting information as in claim 33further comprising the step of:

h) diagnosing a state of said monitored system responsive to said determination of step (g).